APPLICATION OF A PARCEL-BASED SUSTAINABILITY TOOL TO REDUCE GHG EMISSIONS

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Research & Analysis
Southern California Association of Governments

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Southern California Association of Governments (SCAG)

SCAG Quick Facts

- Nation's largest Metropolitan Planning Organization (MPO)
- 6 counties, 191 cities and 38,000+ square miles.
- 18 million people (5.8% of US population; 48.5% of California population)
- GRP in 2010: $910 Billion, 16th largest economy in the world
- 10,000 lane miles of freeway; 4 major airports; Nation's global gateway for trade

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Research Objective

- Greenhouse Gas (GHG) emission is directly linked to travel distance of a vehicle. Vehicle miles of travel (VMT) is used to estimate overall GHG emission.
- This research is to develop a comprehensive method to estimate the impact of land use scenario on VMT per household.
- This model should be sensitive and accurately reflect land use characteristics, so it can be a supplemental tool which augments SCAG's regional model.

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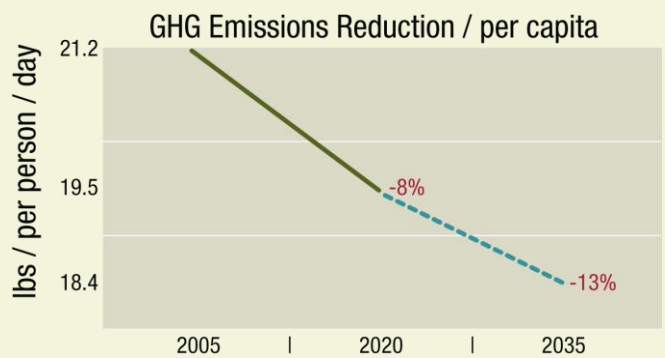
California Senate Bill 375 (SB 375)

- The nation's first law to control GHG through coordination between land use planning and transportation planning
- MPOs are required to develop "Sustainable Community Strategies" (SCS) through integrated land use and transportation planning, and demonstrate an ability to attain the proposed reduction targets by 2020 and 2035.
- The target of emission reduction focuses on both passenger vehicles and light duty trucks.
- A common approach to measure the effectiveness of various SCS is to examine the associated VMT of each strategy.

GHG Emission Target

- California Air Resources Board (ARB) issued a target of per capita GHG emission reduction for SCAG from year 2005:
  - 8% reductions for 2020, and 13% for 2035



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Land Use and Regional Transportation Plan

- SB 375 promotes Transit-Oriented Development (TOD) as a land use approach to reduce GHG emissions in the Regional Transportation Plan (RTP).
- Characteristics of TOD include high residential density, mixed use, and closeness to major transit stops. It is assumed that people living in TOD neighborhoods are more likely to reduce their reliance on a car, and use more non-motorized modes.
- SCAG develops a TOD land use scenario as an element for the 2012 RTP.
- Regional GHG emission will be reduced if more housing supply in TOD areas.

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SCAG Travel Demand Model

- SCAG uses a regional travel demand model to estimate vehicle use and emissions.
- The model is enhanced for analyzing land use impact:
  - Add land use variables (mixed density, walk/transit accessibility)
- However, the regional model may not fully estimate GHG emission reduction from land use scenarios, because:
  - Land use variables are calculated based on TAZs.
  - The size of TAZs is too varied to represent variations among residential neighborhoods.
- An alternative modeling approach is proposed to estimate the impact of land use on vehicle use.

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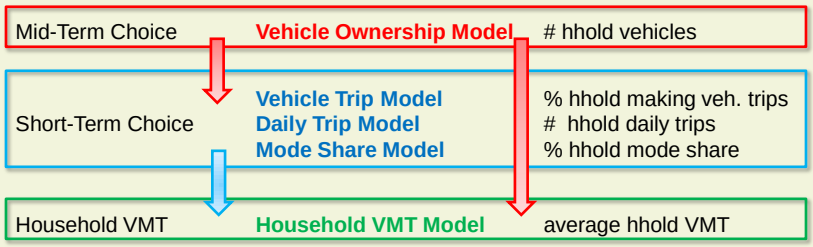
Modeling Approach

- According to choice hierarchy theory (Ben-Akiva, 1977; Salomon, 1982), a travel decision is a sequential process from long-term life style choice, to mid-term mobility choice, and to short-term travel choice.
- We use a sequential modeling approach to develop five household-based sub-models:



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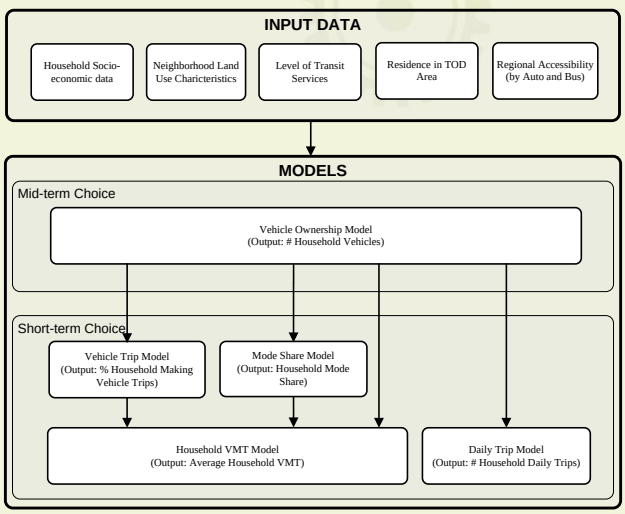
Modeling Approach



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SCAG NHTS Model

- The model is estimated by using the 2009 National Household Travel Survey (NHTS). This model is termed the SCAG NHTS Model.
- The model is to estimate average VMT per household.
  - Weekday travel
  - Passenger vehicles and light trucks
  - Trip production within SCAG region
- This model does not consider:
  - Group quarter population
  - Self selection
  - Relationship between land use policy and residential location choice, such as gentrification

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Variable Description & Data Sources

- Household Travel Data (Dependent Variables)
  - 2009 NHTS
  - 6,700 households, 15,000 persons, 55,000 trips.
- Socioeconomic Characteristics:
  - 2009 NHTS
  - Number of household members by working status and by age cohorts (<16, 16-64, 65+), median household income
- Accessibility
  - TAZ regional job accessibility by auto and local bus
  - Gravity model type, zone-zone time as impedance
  - SCAG model output
- Job-household Ratio
  - Within 5 miles of household TAZ
  - SCAG TAZ socioeconomic data

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Variable Description & Data Sources (cont.)

Neighborhood Land Use

- TAZ or ¼ mile buffer of each sampled household

- Household Density & Employment Density
  - SCAG parcel database (1/4 mi. buffer)
- Street Connectivity
  - SCAG network (1/4 mi. buffer)
- Job Diversity
  - SCAG TAZ employment by 13 industries
- Bus Stop Density
  - Local bus with headway < 15 minutes, SCAG transit network
- TOD area
  - ½ miles buffer of rail stations or major bus stops

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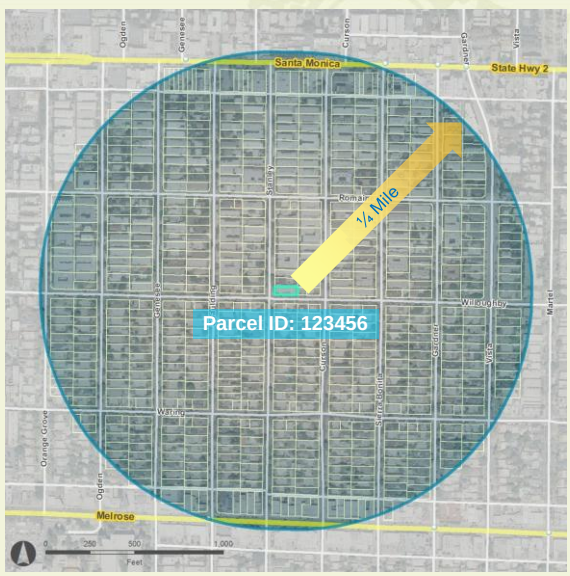
Neighborhood Household Density

(Select Parcels within ¼ Mile Buffer of Each Household)



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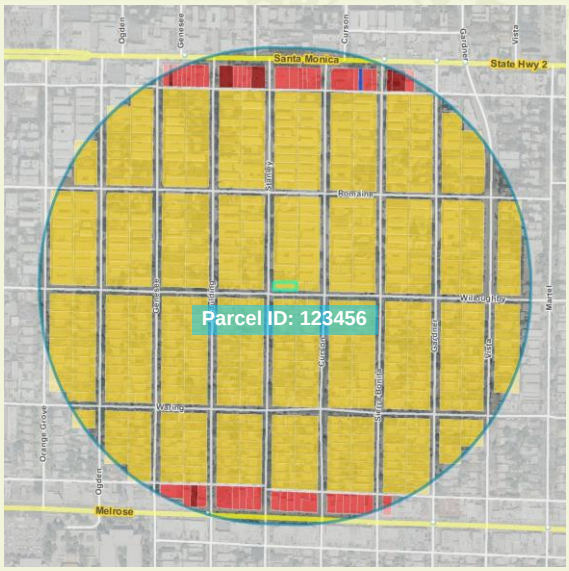
Neighborhood Household Density (cont.)

(Select Residential Parcels within ¼ Mile Buffer)



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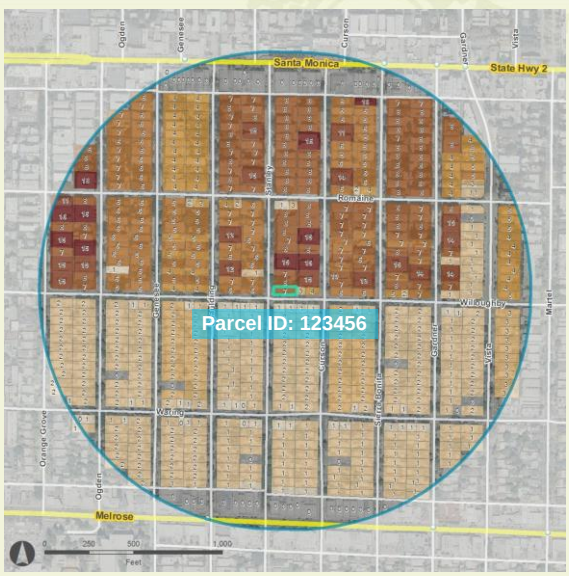
Neighborhood Household Density (cont.)

(Sum up the Number of Households within ¼ Mile Buffer)



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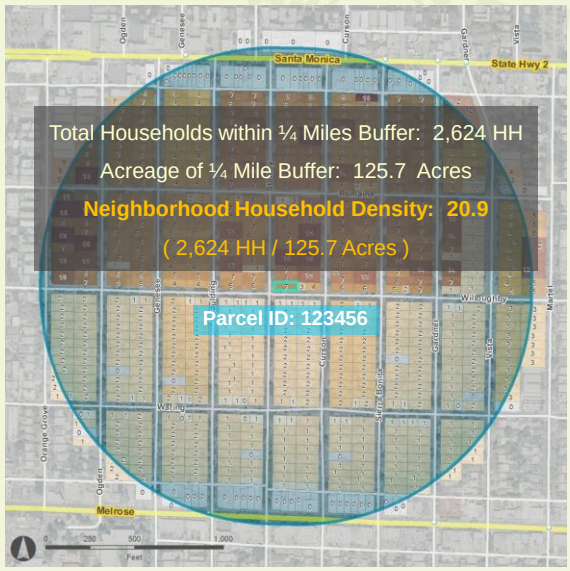
Neighborhood Household Density (cont.)
(Divide Total Households by Area)



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Neighborhood Household Density (cont.)
(Calculate the Household Density for the Entire Parcels)

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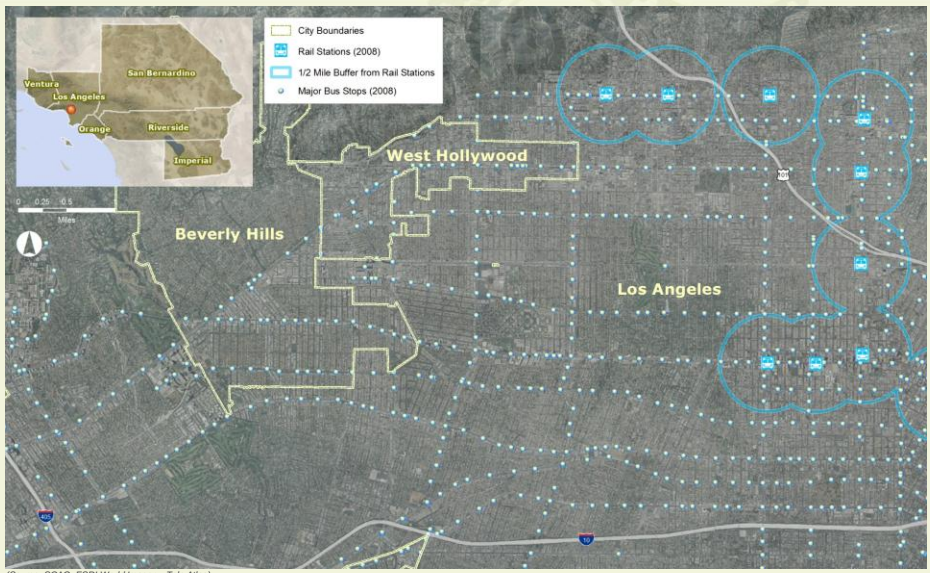
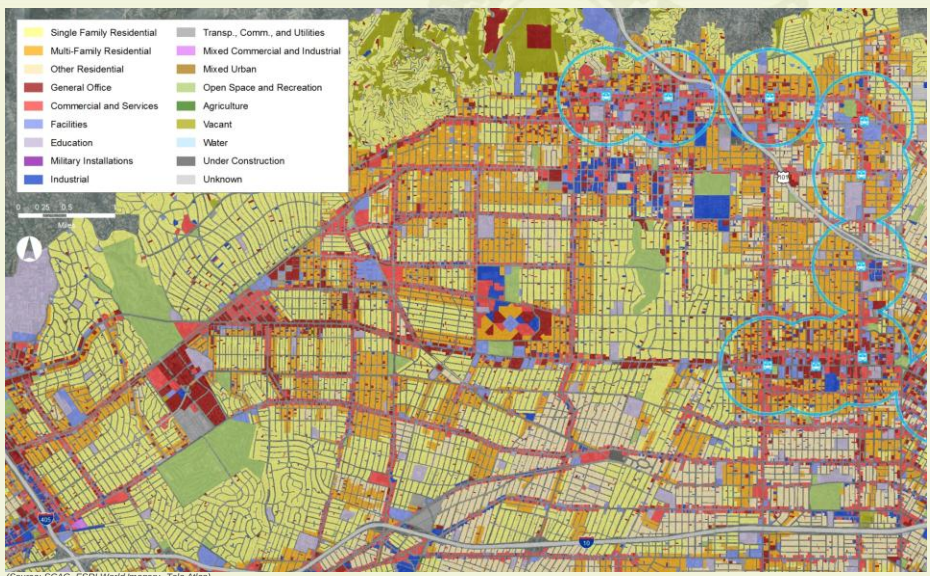
Study Area



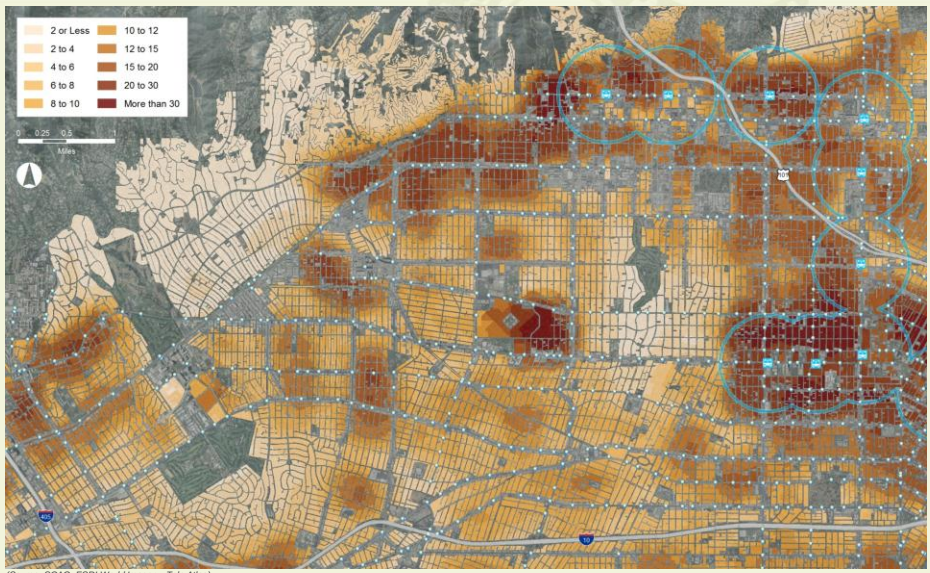
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Existing Land Use
(2008)



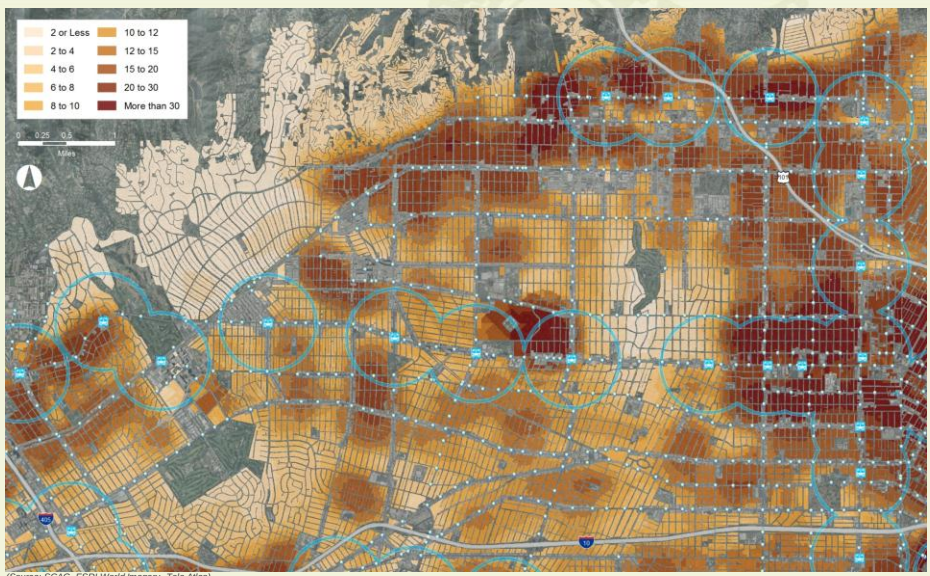
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Household Density within 1/4 Mile Buffer
(2008)



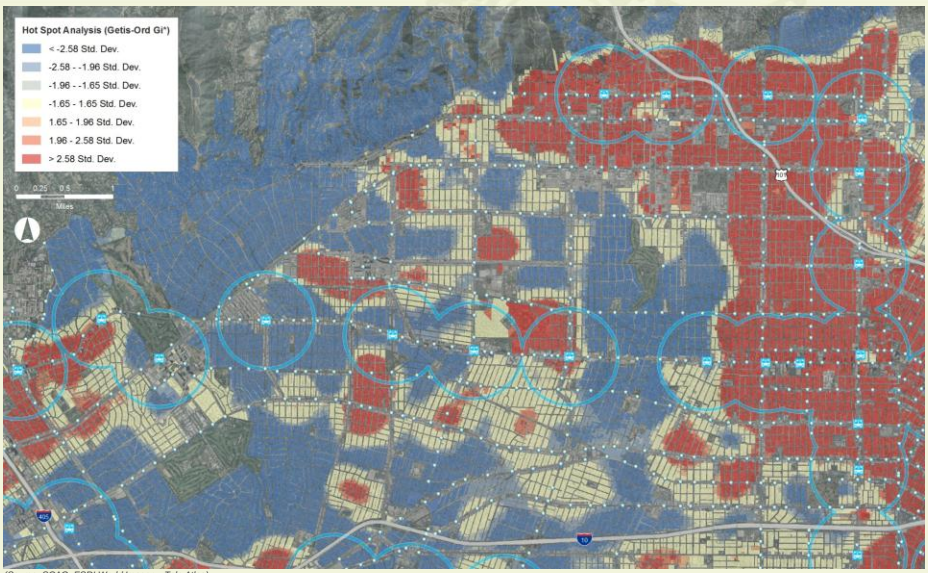
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Household Density within 1/4 Mile Buffer
(2035 Plan)



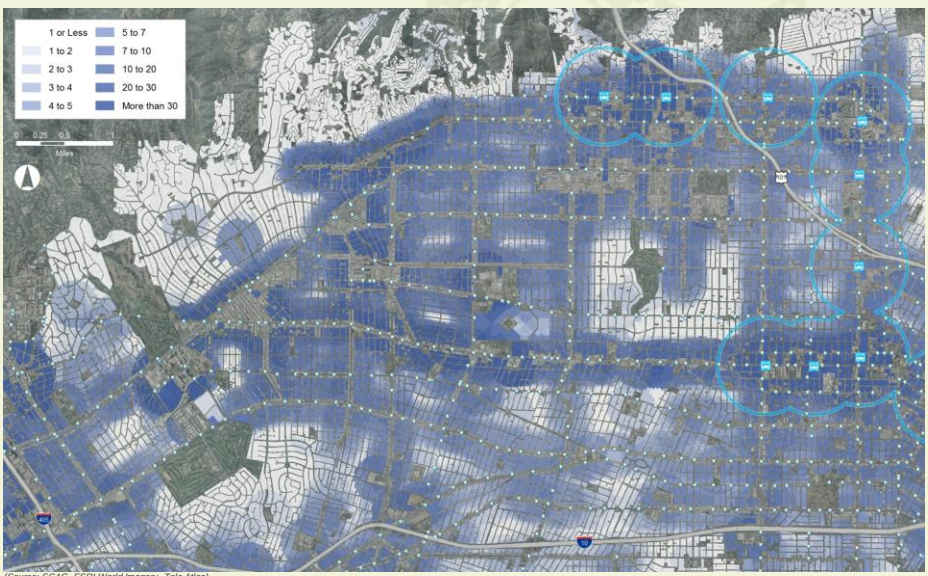
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Household Density Change
(2008 to 2035 Plan)



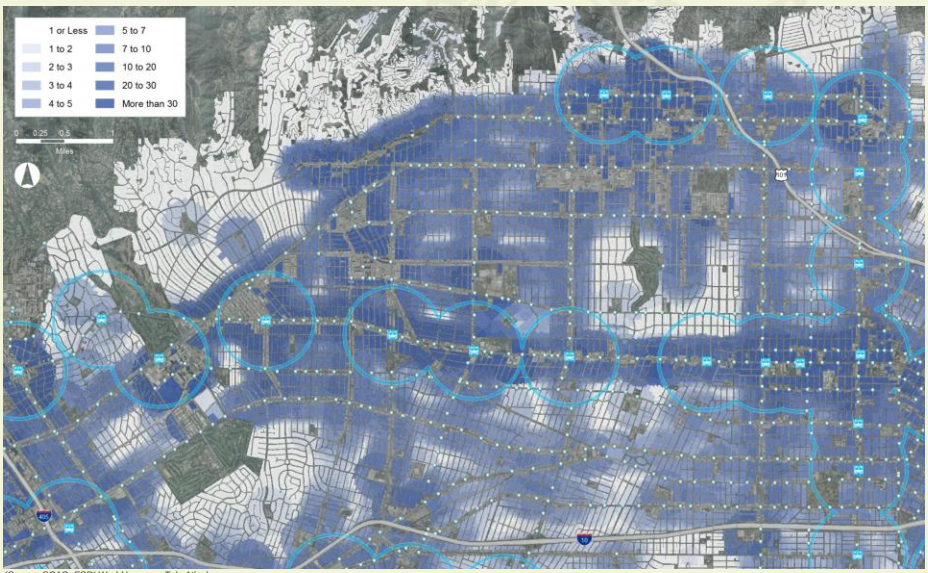
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Employment Density within 1/4 Mile Buffer
(2008)



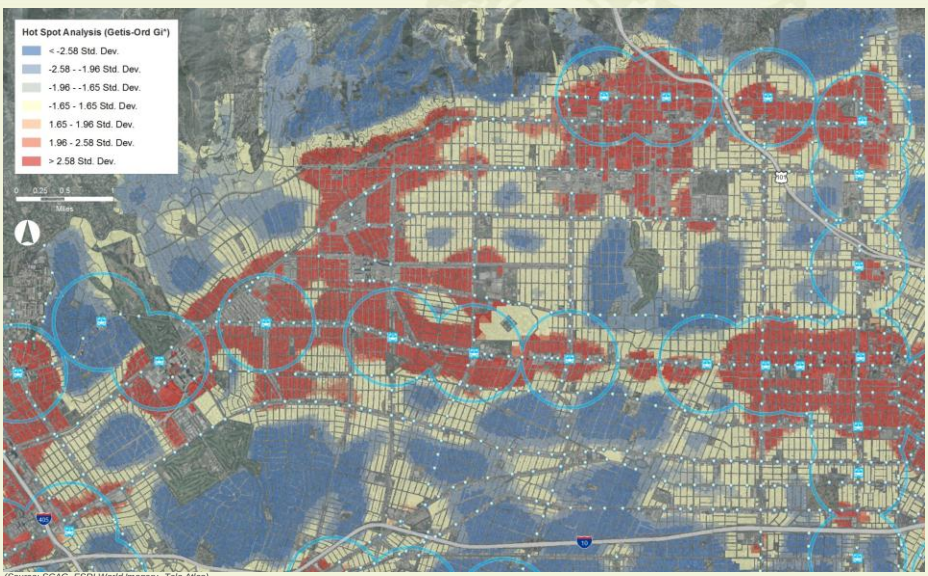
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Employment Density within 1/4 Mile Buffer
(2035 Plan)



(Source: SCAG, ESRI World Imagery, Tele Atlas)

Employment Density Change
(2008 to 2035 Plan)



(Source: SCAG, ESRI World Imagery, Tele Atlas)

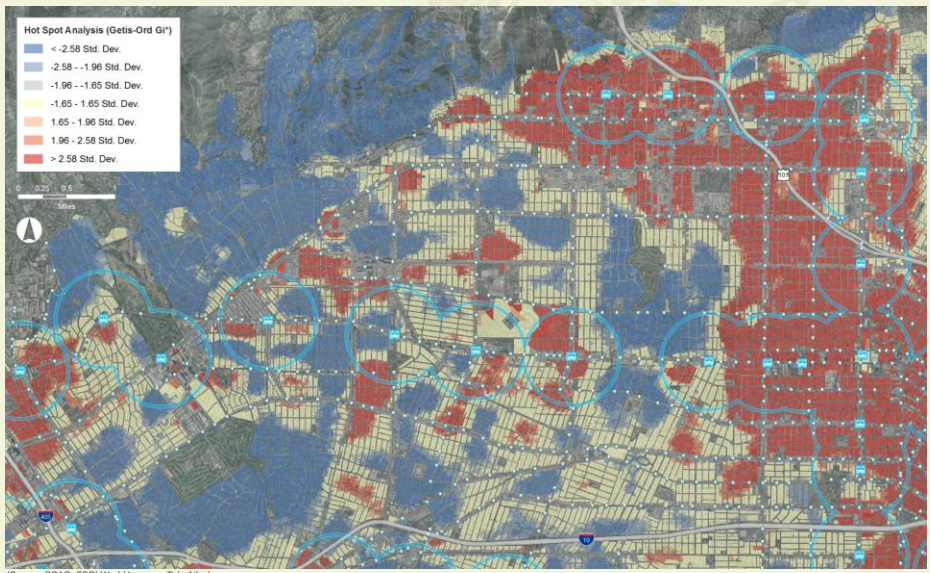
Walkability Index within 1/4 Mile Buffer
(2008)

(Source: SCAG, ESRI World Imagery, Tele Atlas)

Walkability Index within 1/4 Mile Buffer
(2035 Plan)

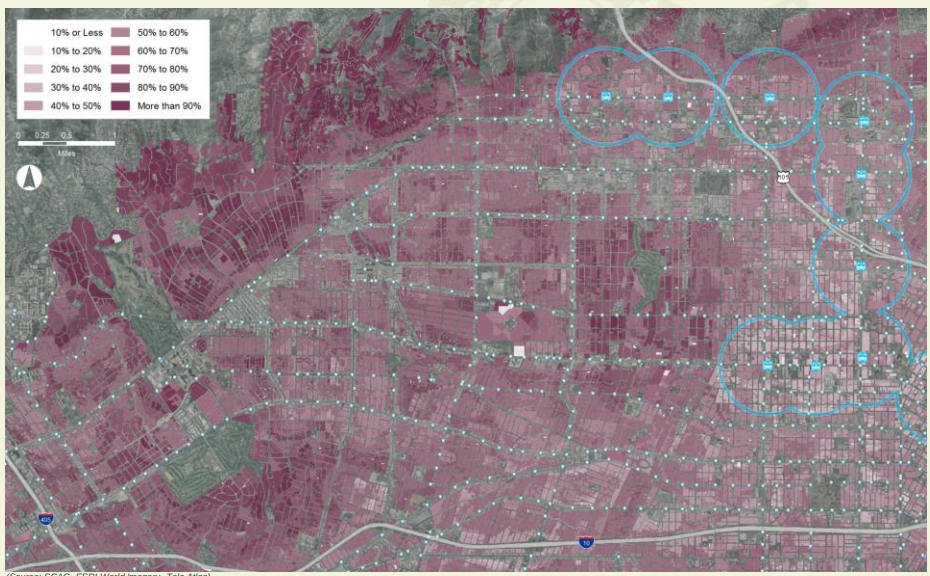
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Walkability Index Change
(2008 to 2035 Plan)



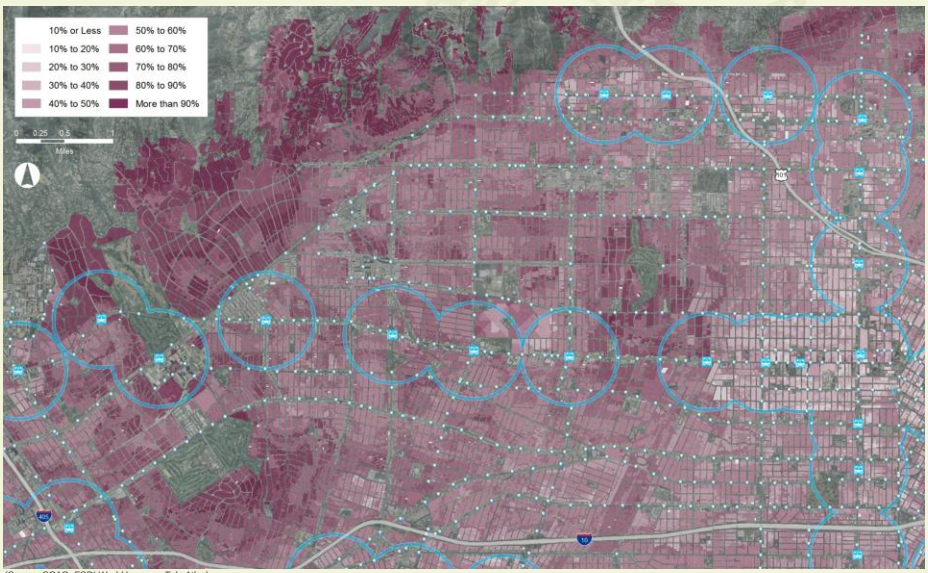
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Mode Share – Auto Driver
(2008)



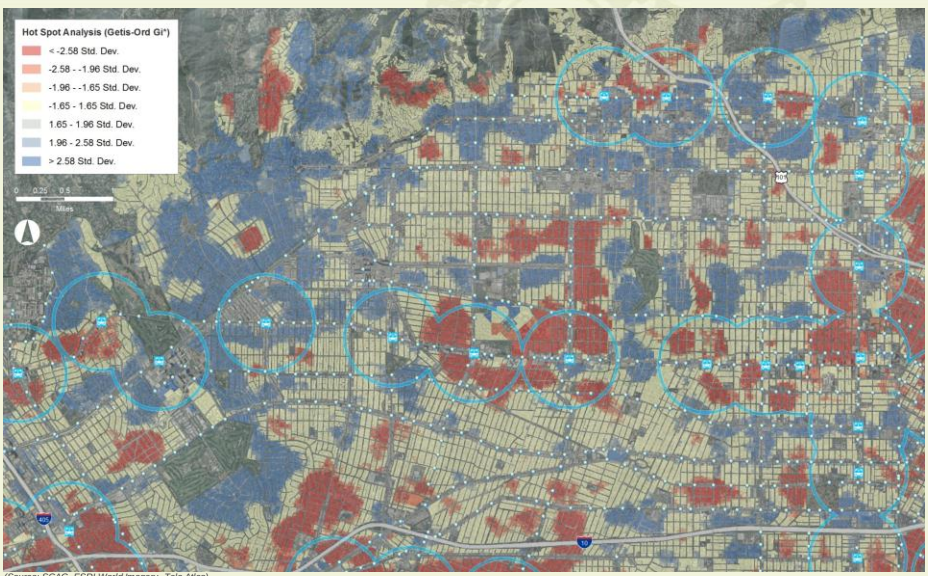
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Mode Share – Auto Driver
(2035 Plan)



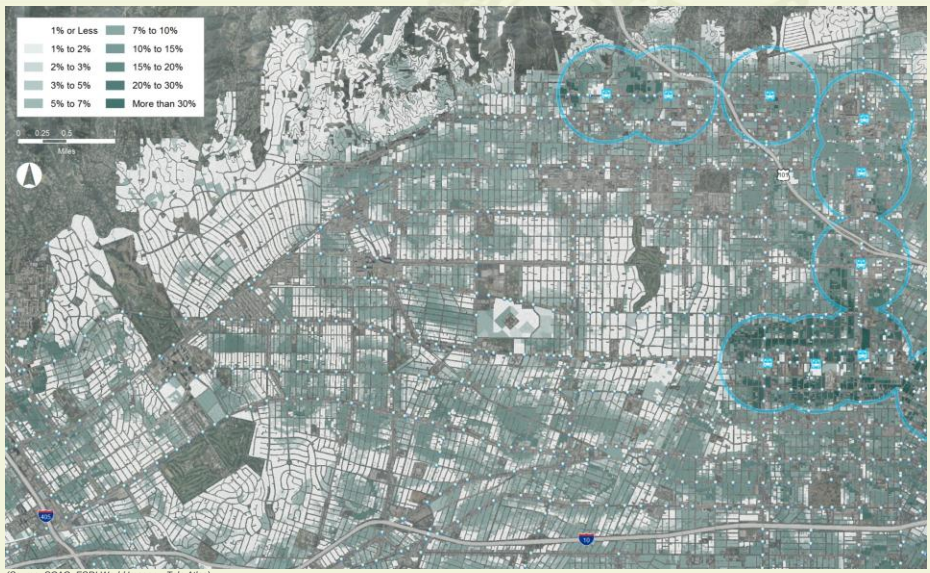
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Mode Share Change – Auto Driver
(2008 to 2035 Plan)



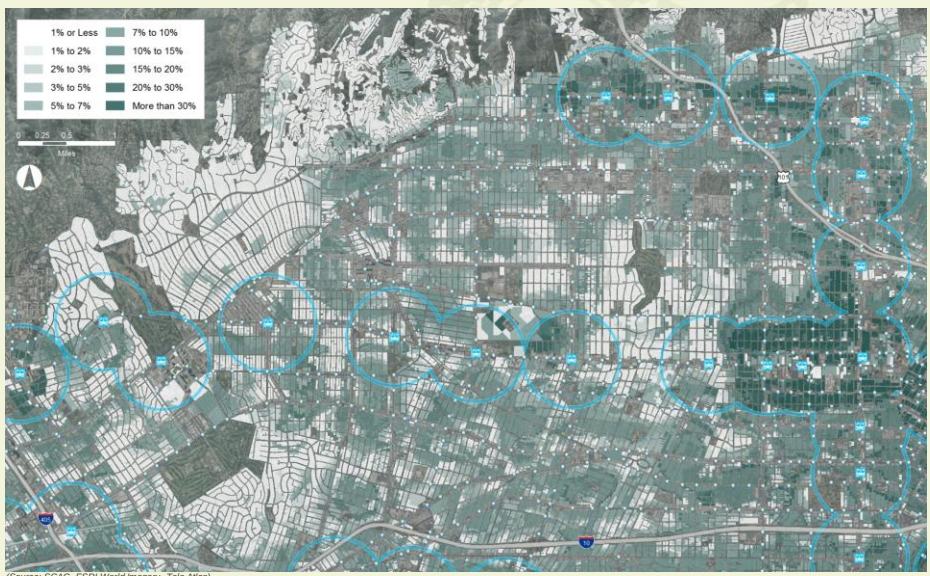
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Mode Share – Transit Passenger
(2008)



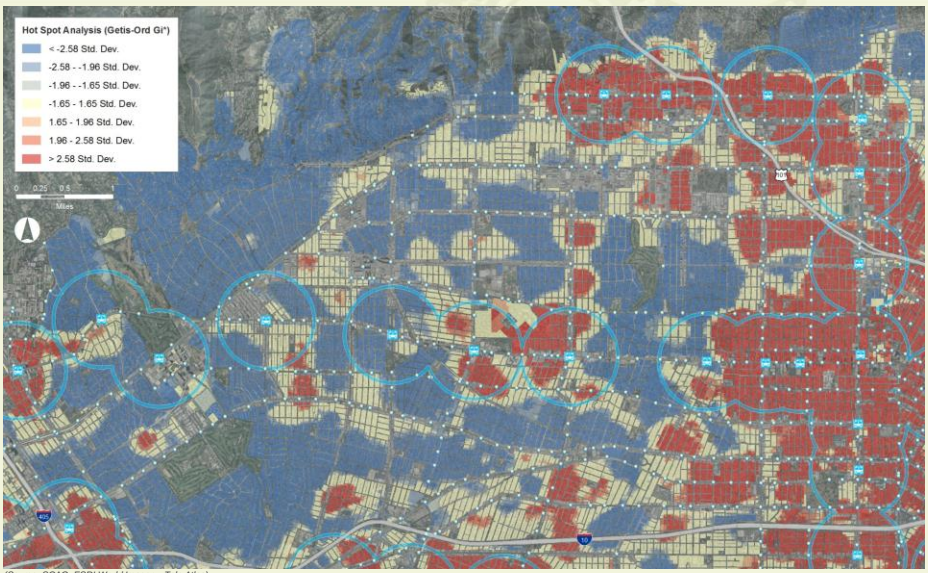
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Mode Share – Transit Passenger
(2035 Plan)



(Source: SCAG, ESRI World Imagery, Tele Atlas)

Mode Share Change – Transit Passenger
(2008 to 2035 Plan)



(Source: SCAG, ESRI World Imagery, Tele Atlas)

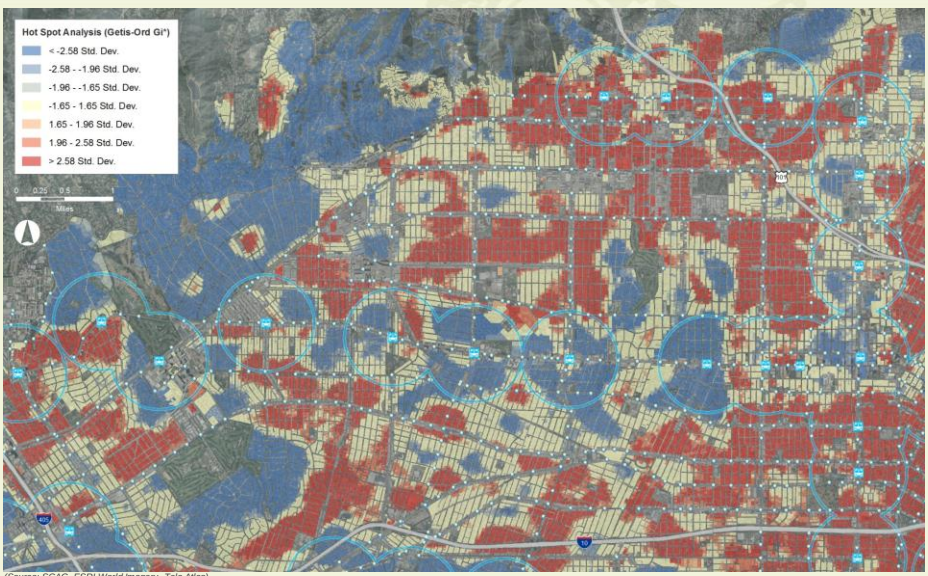
Mode Share – Non-Motorized Modes
(2008)

(Source: SCAG, ESRI World Imagery, Tele Atlas)

Mode Share – Non-Motorized Modes
(2035 Plan)

(Source: SCAG, ESRI World Imagery, Tele Atlas)

Mode Share Change – Non-Motorized Modes
(2008 to 2035 Plan)



(Source: SCAG, ESRI World Imagery, Tele Atlas)

Mode Share Change – SCAG Region
(2008 vs. 2035 Plan)

Mode Share	2008	2035 Plan	% Diff
Auto (Driver)	55.8	55.0	-1%
Auto (Passenger)	26.7	25.1	-6%
Transit	1.3	2.0	50%
Non-Motorized	13.8	15.7	14%
Other	2.4	2.2	-8%

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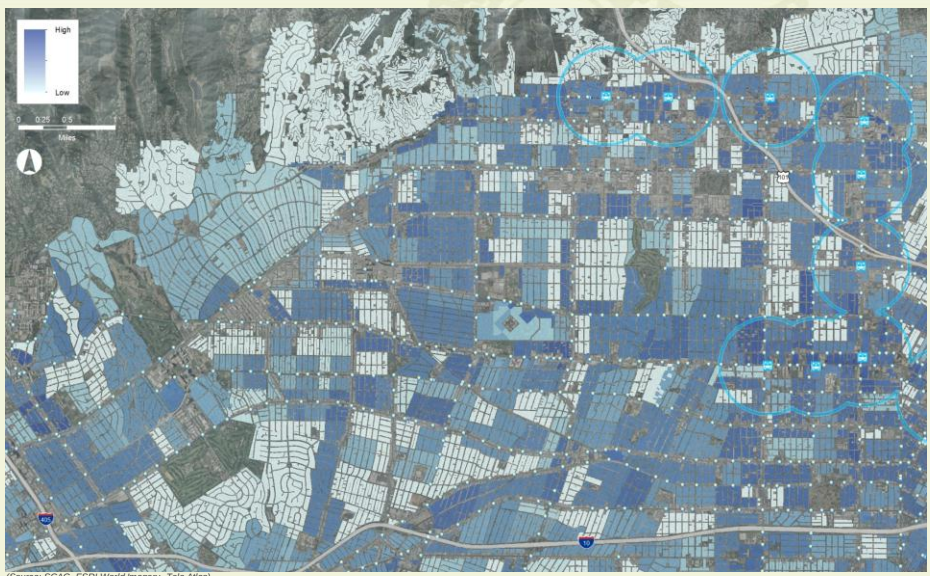
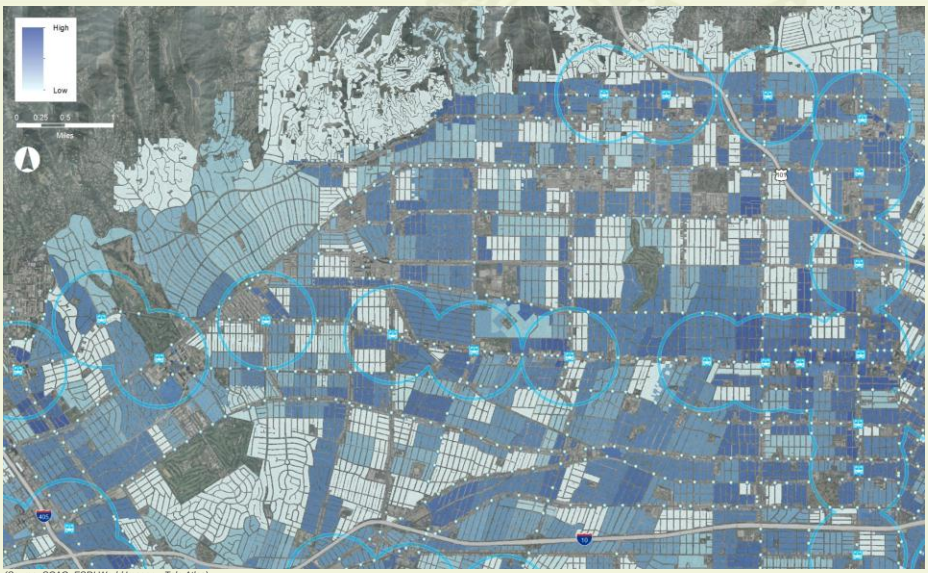
Bus Accessibility
(2008)



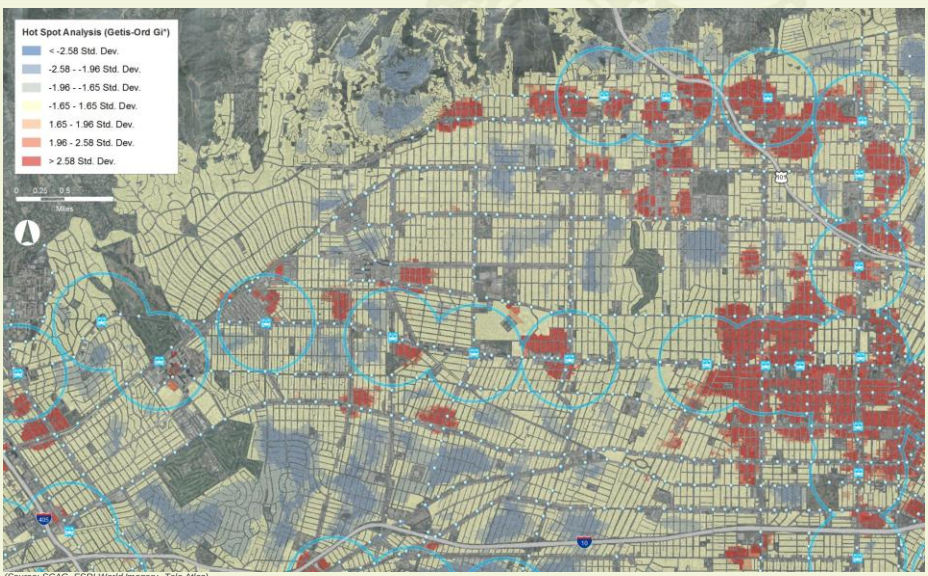
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Bus Accessibility
(2035 Plan)



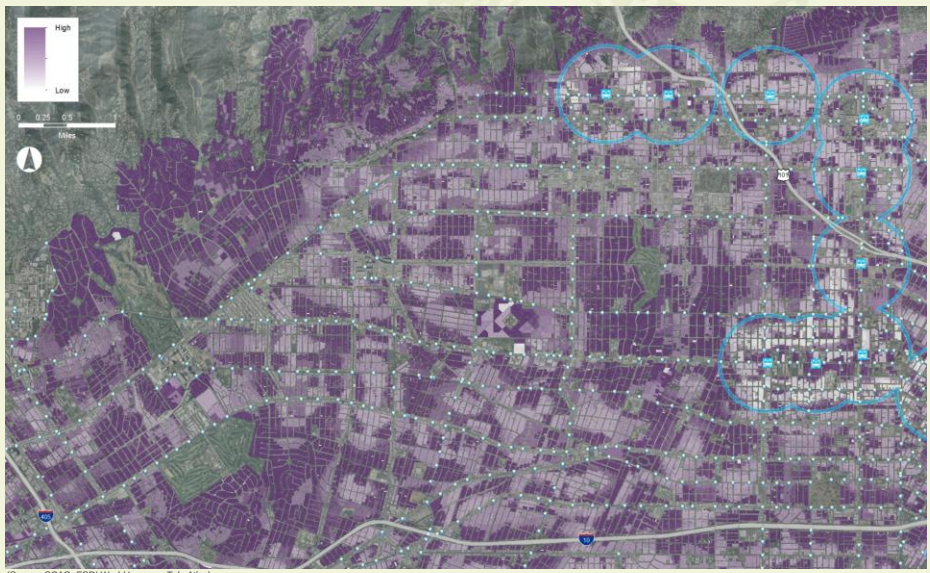
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Bus Accessibility Change
(2008 to 2035 Plan)



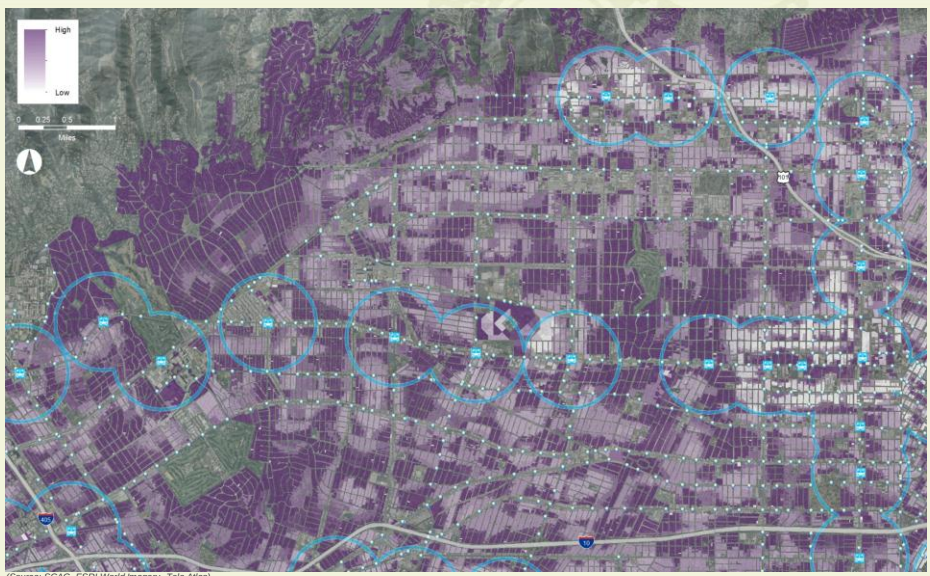
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Reliance on Automobile
(2008)



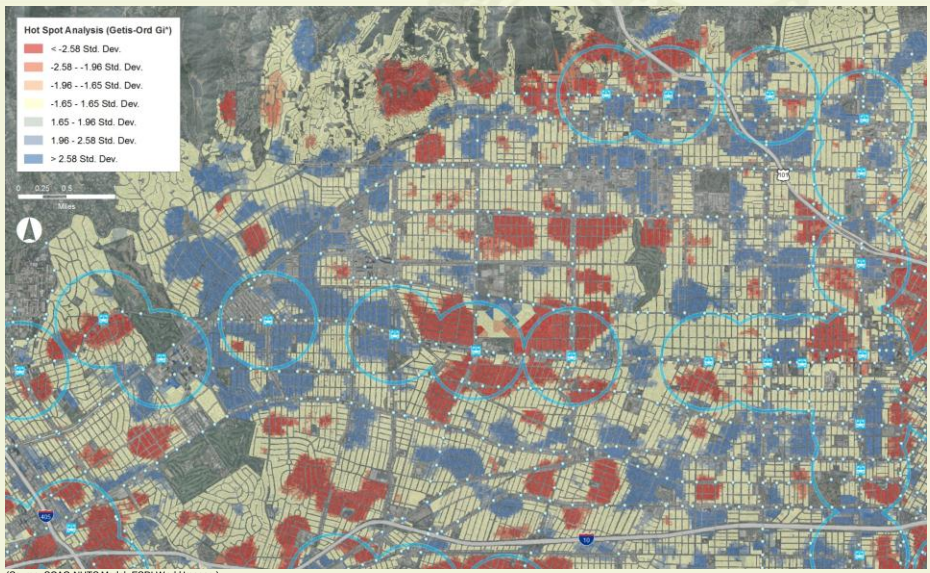
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Reliance on Automobile
(2035 Plan)



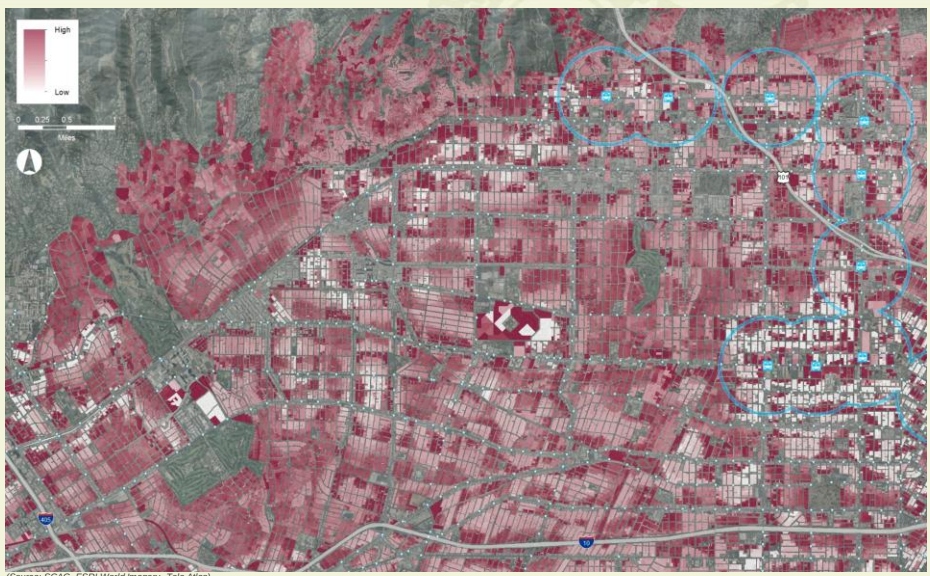
(Source: SCAG, ESRI World Imagery, Tele Atlas)

Change in Reliance on Automobile
(2008 to 2035 Plan)



(Source: SCAG NHTS Model, ESRI World Imagery)

Vehicle Miles of Travel (VMT)
(2008)

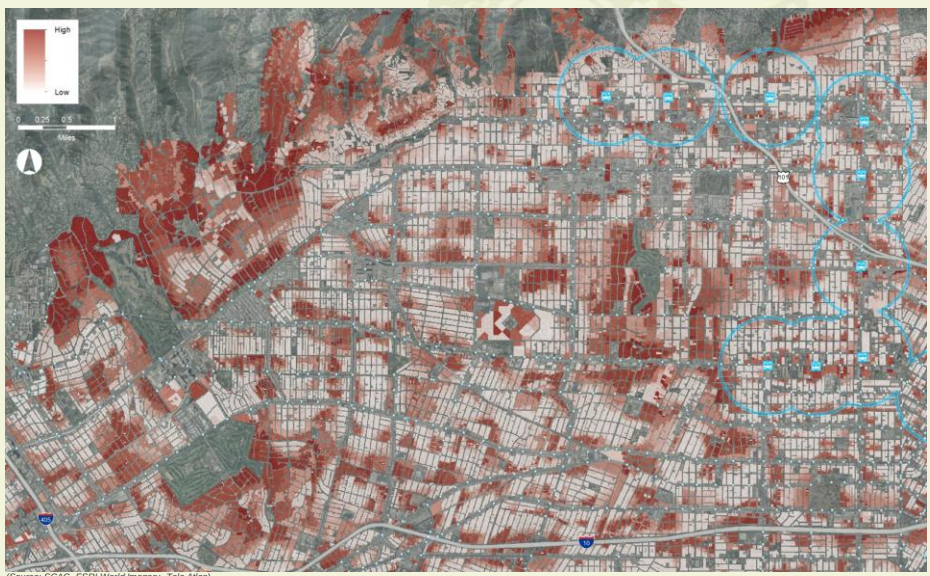


(Source: SCAG, ESRI World Imagery, Tele Atlas)

Vehicle Miles of Travel (VMT)
(2035 Plan)

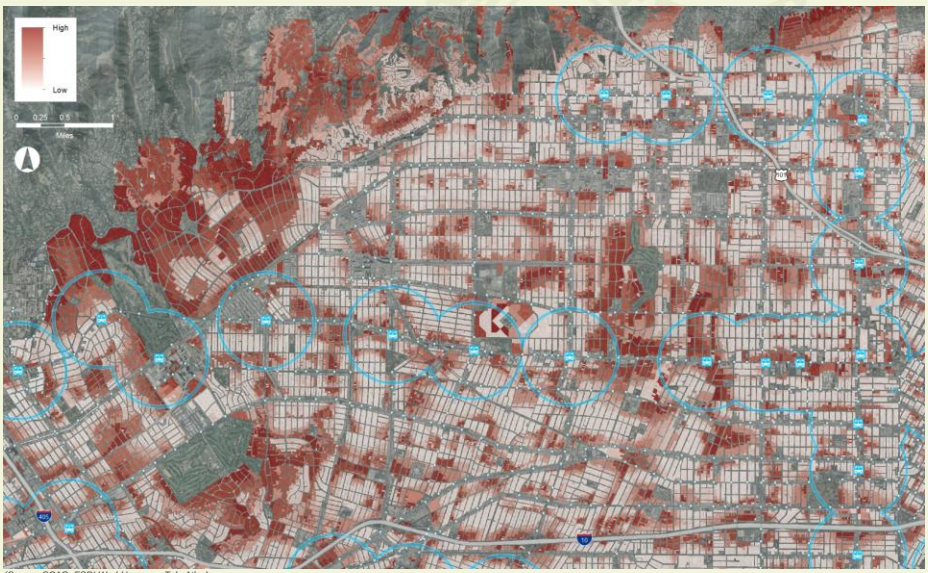
(Source: SCAG, ESRI World Imagery, Tele Atlas)

VMT Per Household
(2008)



(Source: SCAG, ESRI World Imagery, Tele Atlas)

VMT Per Household
(2035 Plan)



(Source: SCAG, ESRI World Imagery, Tele Atlas)

VMT Per Household – Study Area
(2008 vs. 2035 Plan)

VMT / HH	2008	2035 Plan	% Diff
TOD Area Total	**28.3**	**21.5**	**-24.1%**
Rail TOD Area	22.5	20.5	-8.9%
Bus TOD Area	29.6	22.1	-25.3%
Non-TOD Area Total	**58.2**	**51.8**	**-11.1%**
Study Area Total	29.5	22.6	-23.4%

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Summary

Conclusion

Thank you!

Jung Seo

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